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Fingal's Cave

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FINGAL'S CAVE.

AN

Historical, Archæological and Geological

EXAMINATION OF

FINGAL'S CAVE,

IN THE ISLAND OF STAFFA.

Rewritten and Enlarged from the Original Report
Made to the
SMITHSONIAN INSTITUTION,
In the year 1887.

BY J. P. MACLEAN,
*Honorary Member of the Gaelic Society of Inverness; Corresponding Member of the
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"Antiquity of Man," "Mastodon, Mammoth and Man."*

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CINCINNATI:
ROBERT CLARKE & CO.

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ADVERTISEMENT.

On April 18th, 1887, the following letter was received from the late Professor Spencer F. Baird:

"SMITHSONIAN INSTITUTION,
WASHINGTON, D. C., *April 15, 1887.*

Dear Sir:—I enclose a communication just received from Prof. Mason, making some suggestions in regard to your intended examination of Fingal's Cave, &c.

Yours truly,
SPENCER F. BAIRD.

PROF. J. P. MACLEAN."

"UNITED STATES NATIONAL MUSEUM,
Under Direction of The Smithsonian Institution,
WASHINGTON, *April 14, 1887.*

MR. W. J. RHEES—

My Dear Sir: It would be very desirable to have Dr. MacLean make a critical examination of Fingal's Cave, and other antiquities in the neighborhood, because his long experience in this country with Archæological matters will enable him to bring a large degree of practical knowledge to the solution of a problem which has been very much mystified by theories.

It seems incredible that any one should suppose these caves to be the work of man. It is quite possible, however, that evidence of very ancient occupation may be discovered by those who know how to look for them.

Wishing Dr. MacLean great success in his undertaking,

I am, very truly yours,

O. T. MASON."

Now there arose up a new king over Egypt, which knew not Joseph.

—BIBLE.

I. THE ISLAND OF STAFFA.

THE island of Staffa constitutes one of the inner Hebrides, being situated on longitude $6^{\circ}20'$ west from Greenwich and on north latitude $56^{\circ}26'$. It is seven miles distant from the west coast of the southern part of the Isle of Mull, and removed six miles due north of the most northerly point of the Ross of Mull, or rather that part nearest the island of Iona. A line drawn from the extreme northern part of Iona to the extreme western point of Gometra, would pass through Staffa. This would locate it in the great bay formed by the two arms of the Isle of Mull, which contains a group of over twenty islands, not including the massive rocks, which are laid bare during the ebb of the tide. Staffa is oval in shape, its greater breadth being one mile, and its lesser diameter one-half mile.

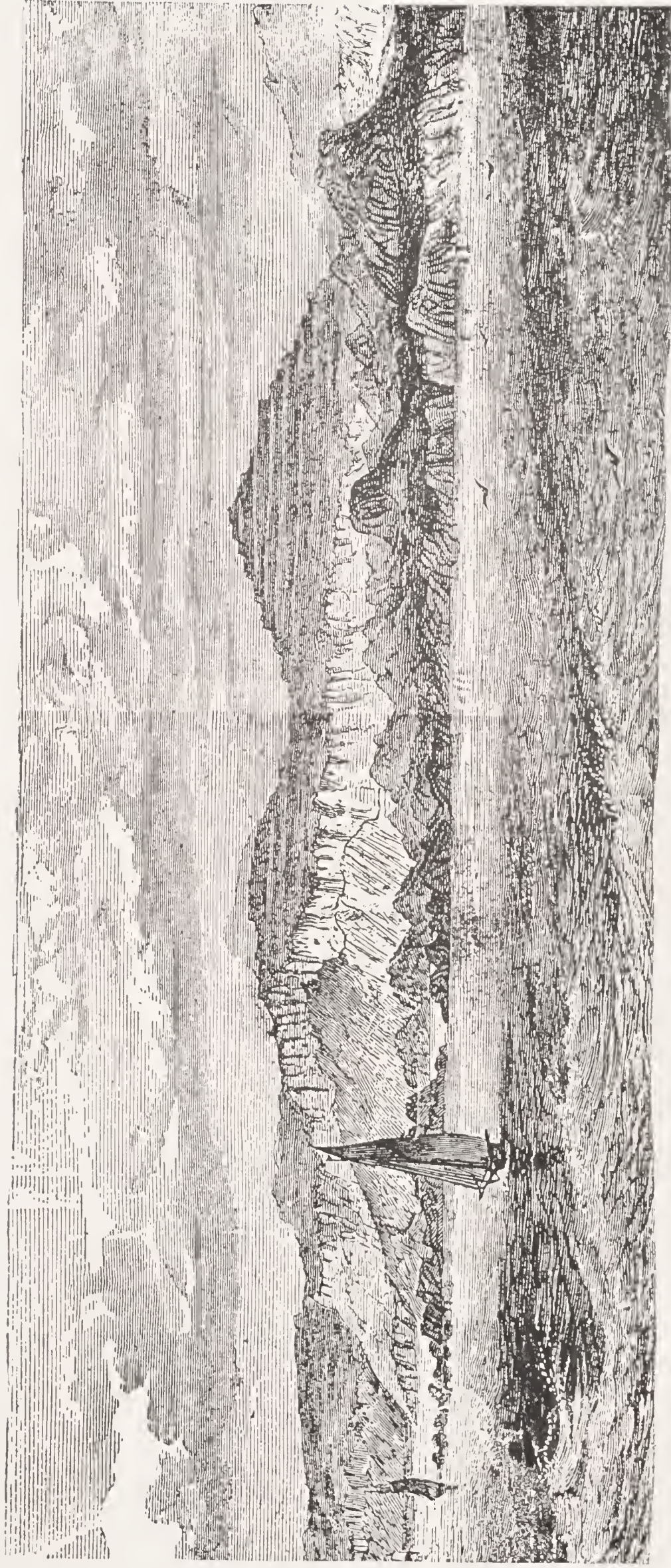
Viewed from a distance, the island is insignificant in comparison with surrounding isles, and one which would not provoke remark unless special attention should be called to it. Standing near the north end of Iona, Staffa appears to be a low projecting rock jutting out from Ulva and Gometra, with the mountains of Mornish, in Mull, forming a background. Looking north-east, the perpendicular cliffs of Gribun and Ardmeadhnach, in places twelve hundred feet in height, the summit of lofty Ben More, and the trap terraces of Bourg, present a near and commanding view. In the distance, to the left, may be seen Rum, Egg and the Cuchulin Hills of Skye. Apparently Nature has erected these great structures and unique scenery, in order to surprise the mind with the wonders revealed on Staffa.

Gribun.

Ben Mor.

Trap Terrace of Bourg.

Granite Hills.



VIEW OF ADJACENT COAST OF MULL.

If the great prominence of Mull, along its western coast, creates a disappointment on first viewing Staffa, that impression is fully removed, immediately on reaching the island. Although the highest point of Staffa does not exceed one hundred and forty-four feet, yet its surface is very rugged, and its contour irregular.



STAFFA, WITH COLONNADE.

In places the basaltic columns break through and form avenues, guarded by rocks of peculiar forms. These avenues are not peculiar alone to Staffa, for they may be noticed on the Ross of Mull and the Garvelloch Isles. On the latter they may be seen, in some instances winding, and in others, presenting a straight course.

The Isle has but one landing point, which is in the north-east, in the lee of the prevailing winds, where is a tract of low shore stretching out in beaches, and only accessible when the ocean permits. If the sea is quiet a landing may be effected in other places by rowing close to low broken columns and then by a quick move-

Staffa.



VIEW FROM NORTH OF IONA, LOOKING NORTH.

ment springing upon the ends of projecting rocks. The summit is gained by a stairway recently constructed.

II. CAVERNS OF STAFFA.

The island owes its celebrity to Fingal's Cave, located in its extreme southern point. Close to and west of Fingal's Cave is the Boat Cave. It is accessible only by sea. Its height is fifteen feet; breadth twelve feet, and depth or length, one hundred and fifty feet.

West of the Boat Cave is MacKinnon's, or the Cormorant Cave, which is easy of access, and terminating in a gravelly beach. This cavern is fifty feet high at its entrance; breadth forty-eight feet, and length two hundred and twenty-four feet.

The Clam-shell cave is on the east shore. It is one hundred and thirty feet long; thirty feet high, and eighteen feet broad at the entrance. This cave presents the peculiarity of having the columns on one side bent, forming a series of ribs, not unlike the timbers of a ship; while the opposite side or wall is formed by the ends of columns, presenting the appearance of a honey-comb.

The columns composing the caverns have short joints, fitting together by the ball and socket process. Both concave and convex extremities are presented on the surface, where the columns have been broken, or the upper joints removed. It could only be determined by actual count whether the concave or convex extremity predominated on the surface of the exposed joints. The columns are so perfectly jointed that the point of a knife will not pass between. The average

diameter of the columns is two feet, although some may approach four feet. The hexagonal and pentagonal forms predominate, although mixed with figures of three, four, and even eight and nine sides, but rarely reaching ten.

III. FINGAL'S CAVE.

Fingal's Cave is approached from the eastern side of the isle, and reached by passing over the upright ends of broken columns, and leaving on the left the Herdsman,—a severed rock, thirty feet high, formed of small columns. Passing the southern-most extremity of the island, and turning suddenly to the right, the entrance of the cavern is presented. Whatever disappointment the first view of Staffa may have occasioned, or the impression made by the cave whilst in the ship, is now thoroughly dissipated. It requires no previous knowledge to be impressed by this great wonder. There are many larger caverns, but nowhere else is there a great hall of columns standing round an ocean floor, and sending forth, in ceaseless reverberations, the measured music of the waves. No other wonder produces such an effect upon the mind. Glancing in, there may be seen solid basaltic pillars rising on the eastern side to a height of eighteen, and on the western thirty-six feet. Two lines of broken columns greet the eye, over one of which the intruder must pass in order to reach the extremity. Above columns may be seen extending from the roof, while the center of the arch, apparently, appears to be formed of a different material. The arch above presents as striking a figure as any other part of the cavern. The lofty pillars are exceedingly hard and as rough as un-

polished iron, almost grating the hand when it is passed over them. Between the pillars, at different points, are traces of a layer of an infiltration of lime.

For a knowledge of the cavern, the world was first indebted to Sir Joseph Banks, unless a very brief notice by Buchanan be made an exception. The account written by Sir Joseph Banks was communicated to Thomas Pennant, who published it in the second volume of his "Tour in Scotland," in 1774, accompanied with six illustrations, taken from Sir Joseph's drawings. Sir Joseph visited the island on August 12th, 1772; and as his account is the first detailed description of both Staffa and Fingal's Cave, it is here inserted in full:

"In the sound of Mull we came to anchor, on the Morvern side, opposite to a gentleman's house, called Drimnen; the owner of it, Mr. MacLean, having found out who we were, very cordially asked us ashore: we accepted his invitation, and arrived at his house, where we met an English gentleman, Mr. Leach, who no sooner saw us than he told us, that about nine leagues from us was an island where he believed no one even in the Highlands had been, on which were pillars like those of the Giant's Causeway: this was a great object to me who had wished to have seen the causeway itself, would time have allowed: I therefore resolved to proceed directly, especially as it was just in the way to the Columb Kill (Iona); accordingly, having put up two days' provisions, and my little tent, we put off in the boat about one o'clock for our intended voyage, having ordered the ship to wait for us in Tobermory, a very fine harbor on the Mull side.

"At nine o'clock, after a tedious passage, having had not a breath of wind, we arrived, under the direction



CLAM-SHELL CAVE, SHOWING BENDING PILLARS.

of Mr. MacLean's son, and Mr. Leach. It was too dark to see any thing, so we carried our tent and baggage near the only house upon the island, and began to cook our suppers, in order to be prepared for the earliest dawn, to enjoy that which from the conversation of the gentlemen we had now raised the highest expectation of.

“The impatience which everybody felt to see the wonders we had heard so largely described, prevented our morning's rest; every one was up and in motion before the break of day, and with the first light arrived at the S. W. part of the island, the seat of the most remarkable pillars; where we no sooner arrived than we were struck with a scene of magnificence which exceeded our expectations, though formed, as we thought, upon sanguine foundations; the whole of that end of the island supported by ranges of natural colonnades, according as the bays or points of land formed themselves: upon a firm basis of solid unformed rock above these, the stratum which reaches to the soil or surface of the island, varied in thickness, as the island itself formed into hills or valleys; each hill, which hung over the columns below, forming an ample pediment; some of these above 60 feet in thickness, from the base to the point, formed, by the sloping of the hill on each side, almost into the shape of those used in architecture.

“Compared to this what are the cathedrals or the palaces built by men! mere models or playthings, imitations as diminutive as his works will always be when compared to those of nature. Where is now the boast of the architect! regularity the only part in which he fancied himself to exceed his mistress, Nature, is here found in her possession, and here it has been for

ages undescribed. Is not this the school where the art was originally studied, and what had been added to this by the whole Grecian school? a capital to ornament the column of nature, of which they could execute only a model; and for that very capital they were obliged to a bush of Acanthus : how amply does nature repay those who study her wonderful works !

“With our minds full of such reflections we proceeded along the shore, treading upon another Giant's Causeway, every stone being regularly formed into a certain number of sides and angles, till in a short time we arrived at the mouth of a cave, the most magnificent, I suppose, that has ever been described by travelers.

“The mind can hardly form an idea more magnificent than such a space, supported on each side by ranges of columns ; and roofed by the bottoms of those which have been broken off in order to form it ; between the angles of which a yellow stalagmitic matter has exuded, which serves to define the angles precisely ; and at the same time vary the color with a great deal of elegance, and to render it still more agreeable, the whole is lighted from without ; so that the farthest extremity is very plainly seen from without, and the air within being agitated by the flux and reflux of the tides, is perfectly dry and wholesome, free entirely from the damp vapors with which natural caverns in general abound.

“We asked the name of it ; said our guide, the cave of Fiubn ; what is Fiubn ? said we ; Fiubn MacCoul, whom the translator of Ossian's works has called Fingal ; how fortunate that in this cave we should meet with the remembrance of that chief, whose existence, as well as that of the whole Epic poem, is almost doubted in England.

“Enough for the beauties of Staffa, I shall now proceed to describe it and its productions more philosophically.

“The little island of Staffa lies on the west coast of Mull, about three leagues N. E. from Iona, or the Columb Kill ; its greatest length is about an English mile, and its breadth about half a one. On the west side of the island is a small bay, where boats generally land ; a little to the southward of which the first appearance of pillars are to be observed ; they are small, and instead of being placed upright, lie down on their sides, each forming a segment of a circle : from thence you pass a small cave, above which, the pillars now grown a little larger, are inclining in all directions : in one place in particular a small mass of them very much resemble the ribs of a ship : from hence, having passed the cave, which, if it is not low water, you must do in a boat, you come to the first ranges of pillars, which are still not above half as large as those a little beyond. Over against this place is a small island, called in Erse, Boo-sha-la, separated from the main by a channel not many fathoms wide ; this whole island is composed of pillars without any stratum above them ; they are still small, but by much the neatest formed of any about the place.

“The first division of the island, for at high water it is divided into two, makes a kind of a cone, the pillars converging together towards the center ; on the other, they are in general laid down flat, and in the front, next to the main, you see how beautifully they are packed together ; their ends coming out square with the bank which they form ; all these have their transverse sections exact, and their surfaces smooth, which is by no means the case with the large ones, which are

cracked in all directions. I must question, however, if any one of this whole island of Boo-sha-la, is two feet in diameter.

“The main island opposite to Boo-sha-la and farther towards the N. W. is supported by ranges of pillars pretty erect, and tho’ not tall, (as they are not uncovered to the base,) of large diameters; and at their feet is an irregular pavement, made by the upper sides of such as have been broken off, which extends as far under water as the eye can reach. Here the forms of the pillars are apparent; these are of three, four, five, six and seven sides; but the numbers of five and six are by much the most prevalent. The longest I measured was of seven; it was four feet five inches in diameter. I shall give the measurement of its sides, and those of some other forms which I met with:

No. 1.—4 sides, diam. 1 ft. 5 in.

	Ft.	In.
Side 1,	1	5
“ 2,	1	1
“ 3,	1	6
“ 4,	1	1

No. 2.—5 sides, diam. 2 ft. 10 in.

	Ft.	In.
Side 1,	1	10
“ 2,	1	10
“ 3,	1	5
“ 4,	1	7½
“ 5,	1	8

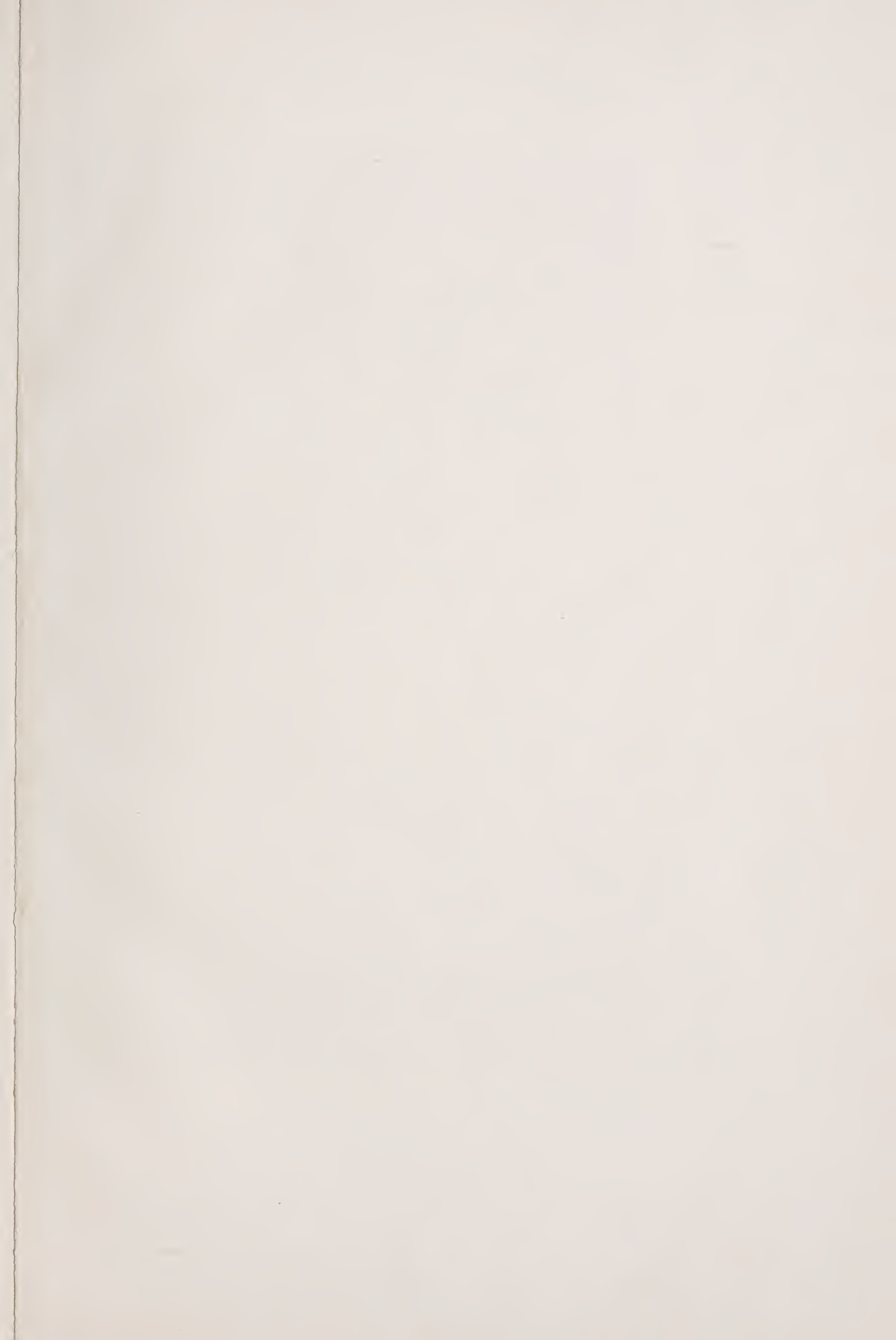
No. 3.—6 sides, diam. 3 ft. 6 in.

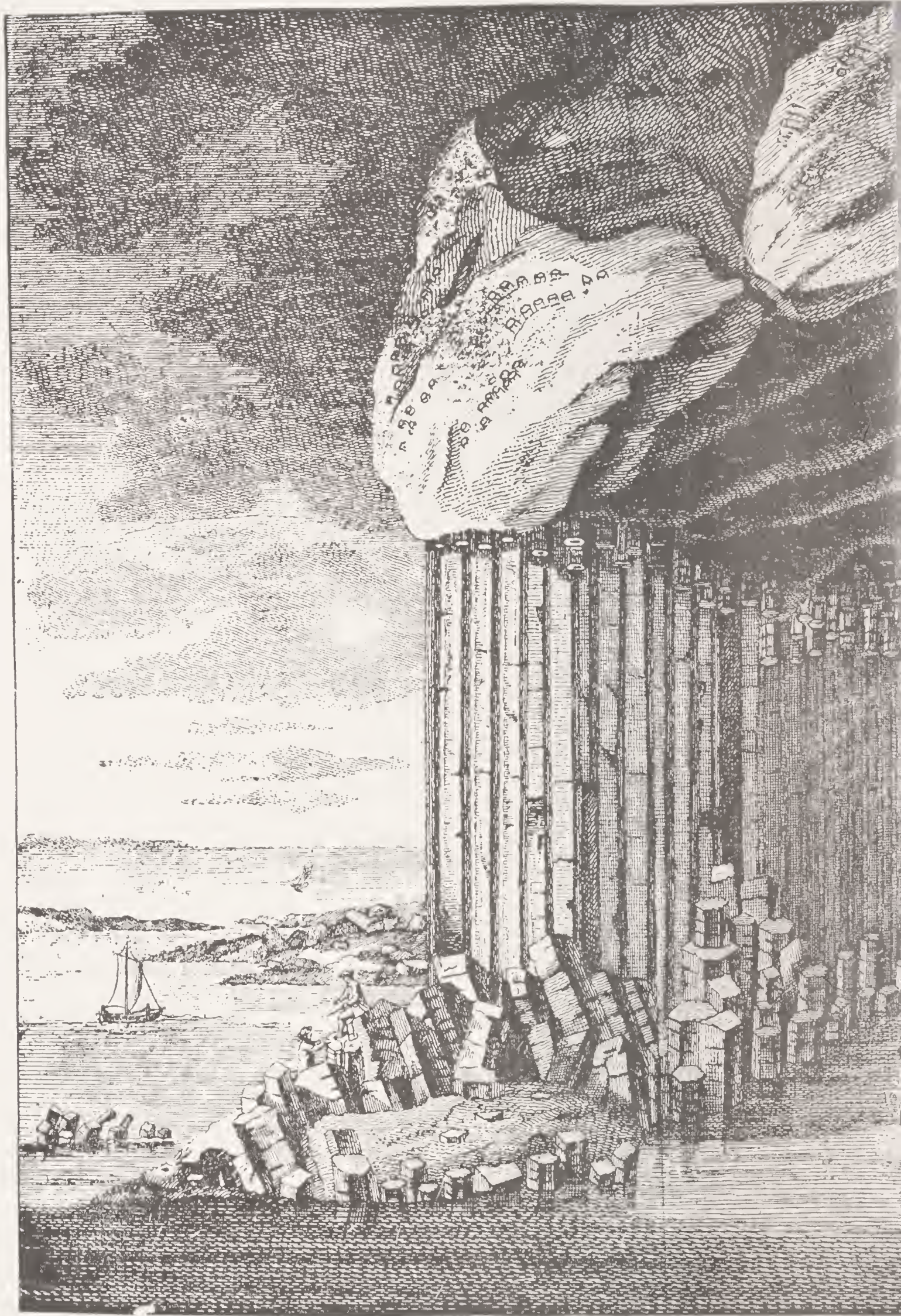
	Ft.	In.
Side 1,	0	10
“ 2,	2	2
“ 3,	2	2
“ 4,	1	11
“ 5,	2	2
“ 6,	2	9

No. 4.—7 sides, diam. 4 ft. 5 in.

	Ft.	In.
Side 1,	2	10
“ 2,	2	4
“ 3,	1	10
“ 4,	2	0
“ 5,	1	1
“ 6,	1	6
“ 7,	1	3

“The surfaces of these large pillars in general are rough and uneven, full of cracks in all directions; the transverse figures in the upright ones never fail to run in their true directions: the surfaces upon which we







SIR JOSEPH BANKS.

walked were often flat, having neither concavity nor convexity: the larger number, however, were concave, tho' some were very evidently convex; in some places the interstices within the perpendicular figures were filled up with a yellow spar: in one place a vein passed in among the mass of pillars, carrying here and there small threads of spar. 'Tho' they were broken and cracked through and through in all directions, yet their perpendicular figures might easily be traced; from whence it is easy to infer, that whatever the accident might have been, that caused their dislocation, it happened after the formation of the pillars.

"From hence, proceeding along shore, you arrive at Fingal's Cave: its dimensions tho' I have given, I shall here again repeat in the form of a table:

	Ft.	In.
"Length of the cave from the rock without,.....	371	6
From the pitch of the arch,.....	250	0
Breadth of ditto, at the mouth,.....	53	7
At the farther end,.....	20	0
Height of the arch at the mouth,.....	117	6
At the end,.....	70	0
Height of an outside pillar,.....	39	6
Of one of the N. W. corner,.....	54	0
Depth of water at the mouth,.....	18	0
At the bottom,.....	9	0

The cave runs into the rock in the direction of N. E. by E. by the compass.

"Proceeding farther to the N. W. you meet with the highest ranges of pillars, the magnificent appearance of which is past all description: here they are bare to their very basis, and the stratum below them is also visible: in a short time it rises many feet above the water, and gives an opportunity of examining its quality. Its surface is rough, and has often large lumps of stone sticking in it, as if half immersed; itself, when broken, is

composed of a thousand heterogeneous parts, which together have very much the appearance of a lava, and the more so as many of the lumps appear to be of the very same stone of which the pillars are formed. This whole stratum lies in an inclined position, dipping gradually towards the S. E. As hereabouts is the situation of the highest pillars, I shall mention my measurements of them and the different strata in this place, promising that the measurements were made with a line held in the hand of a person who stood at the top of the cliff, and reaching to the bottom, to the lower end of which was tied a white mark, which was observed by one who staid below for the purpose when this mark was set off from the water, the person below noted it down, and made signal to him above, who made then a mark in his rope: whenever this mark passed a notable place the same signal was made, and the name of the place noted down as before: the line being all hauled up, and the distances between the marks measured and noted down, gave, when compared with the book kept below, the distances, as for instance in the cave:

“No 1 in the book below, was called from the water to the foot of the first pillar in the book above; No. 1 gave 36 feet 8 inches, the highest of that ascent, which was composed of broken pillars.

No. 1. Pillar at the west corner of Fingal's Cave.	Ft.	In.
1. From the water to the foot of the pillar,.....	12	10
2. Height of the pillar,.....	37	3
3. Stratum above the pillar,.....	66	9
No. 2. Fingal's Cave.		
1. From the water to the foot of the pillar,.....	36	8
2. Height of the pillar,.....	39	6
3. From the top of the pillar to the top of the arch,...	31	4
By adding together the three first measurements, we got the height of the arch from the water,.....	117	6

No. 3. Corner pillar to the westward of Fingal's Cave.	Ft.	In.
Stratum below the pillar of lava-like matter,.....	11	0
Length of pillar,.....	54	0
Stratum above the pillar,.....	61	6
No. 4. Another pillar to the westward.		
Stratum below the pillar,.....	17	1
Height of the pillar,.....	50	0
Stratum above,.....	51	1
No. 5. Another pillar farther to the westward.		
Stratum below the pillar,.....	19	8
Height of the pillar,.....	55	1
Stratum above,.....	54	7

“The stratum above the pillars, which is here mentioned, is uniformly the same, consisting of numberless small pillars, bending and inclining in all directions, sometimes so irregularly that the stones can only be said to have an inclination to assume a columnar form; in others more regular, but never breaking into, or disturbing the stratum of large pillars, whose tops everywhere keep an uniform and regular line.

“Proceeding now along shore round the north end of the island, you arrive at Oua na Scarve, or the Cormorant's Cave: here the stratum under the pillars is lifted up very high; the pillars above it are considerably less than those at the N. W. end of the island, but still very considerable. Beyond is a bay, which cuts deep into the island, rendering it in that place not more than a quarter of a mile over. On the sides of this bay, especially beyond a little valley, which almost cuts the island into two, are two stages of pillars, but small; however having a stratum between them exactly the same as that above them, formed of innumerable little pillars, shaken out of their places and leaning in all directions.

“Having passed this bay, the pillars totally cease;

the rock is of a dark-brown stone and no signs of regularity occur till you have passed round the S. E. end of the island (a space almost as large as that occupied by the pillars) which you meet again on the west side, beginning to form themselves irregularly, as if the stratum had an inclination to that form, and soon arrived at the bending pillars where I began.

“The stone of which the pillars are formed is a coarse kind of Basalt, very much resembling the Giant's Causeway in Ireland, though none of them are near so neat as the specimens of the latter, which I have seen at the British Museum; owing chiefly to the color, which in ours is a dirty brown, in the Irish a fine black; indeed the whole production seems very much to resemble the Giant's Causeway; with which I should willingly compare it had I any account of the former before me.”

It might be well to add at this point that having visited both the Giant's Causeway, and Fingal's Cave, I am able to testify that the latter surpasses the former so much in grandeur that in order to appreciate the Giant's Causeway it should be seen first.

Other measurements of Fingal's Cave vary from that given by Sir Joseph Banks. “The Statistical Account of Argyleshire” (1845, p. 352) gives the following: “The height from the top of the arch to that of the cliff above is 30 feet; and from the top of the arch to the surface of the water at low tide, 66 feet. The pillars by which it is bounded on the western side are 36 feet high; while at the eastern they are only 18. Towards the west, the height of the columns gradually increases, as they recede from the cave to the altitude of 54 feet. The breadth of the cave at the entrance is 42 feet, and this continues to within a small distance

of the inner extremity, when it is reduced to 22. The total length is 227 feet."

"Chambers' Encyclopædia" (vol. ix, article "Staffa") contains the following dimensions: "The entrance is 33 feet wide, and 60 feet high, and the length of the cave is 212 feet." Appleton's "American Encyclopædia" (article "Staffa") has the following: Length 227 feet; breadth at entrance, 42 feet; breadth at inner end, 22 feet; depth of water in floor of cave at low water mark, 20 feet; height of rock above arch, 30 feet; and, height of arch above mean tide, 60 feet. Cameron's "Staffa and Iona," (page 11,) varies somewhat from all others: "This cave is 227 feet long, 42 feet broad, 66 feet high, and at ebb has 25 feet of water."

Other measurements have been given which need not be enumerated. The differences may result from different points decided upon, or quoting from careless writers, or else from a desire to appear to be more accurate than others.

It is not to be assumed that Fingal's Cave was unknown prior to the year 1772. Standing in its entrance, the tower of the cathedral of Iona may be distinctly seen. Sir Walter Scott's attention was called to this, and in his "Lord of the Isles" he is moved to say,

"Nor doth its entrance front in vain
To old Iona's holy fane,
That Nature's voice might seem to say,
'Well hast thou done, frail child of clay!
Thy humble powers that stately shrine
Task'd high and hard—but witness mine!"

As the island of Iona was a very important spot to the Christian from the year 565 to the year 1560, during which time it was not only a seat of learning, but also

frequented by the learned of Europe, and the burial spot of sixty-four kings, besides many prominent chiefs of clans and ecclesiastical dignitaries, it would be doing violence to all history to presume that the Cave should remain unknown. Even if the Gaël did not proclaim its wonders, that would not be in the least singular because such things did not receive much attention, or awaken any interest in that people, and during the previous ages. Then again, it must be remembered that the Hebrides abound in caverns, and what the Gaël had always been accustomed to from childhood did not create in him surprise. He knew the cave and called it Llainn-binn, or Cave of Music. Indeed Sir Joseph Banks records that on asking the name of the cavern, it was readily given him.

Prior to the promulgation of Christianity the cave must have been known to the Druids; for Iona was once a seat of this ancient priesthood, and there they had a school of theology from time immemorial, and which continued until uprooted by St. Columba. Hence, the most ancient name of Iona is Innis nan Druineach—the isle of the Druids.

IV. IS FINGAL'S CAVE OF HUMAN ORIGIN?

The province of the scientist is to observe carefully the course of nature, and from such data as he may be able to collect, draw certain or definite conclusions. It is outside of his true province to combat mere theorists, although he may expose fallacies. Whatever is of interest in the way of scientific knowledge, will be more or less weighted by theorists, who will formulate their ideas, and in their promulgation will be more or less zealous in proportion to their want of knowledge

of the subject—the less knowledge, the more zeal. It may not be surprising to one who has never visited the Hebrides to learn that the theory has been put forth that Fingal's Cave is of human origin. To a person who has stood within its portals, the theory is one entirely too absurd to be regarded with patience. Even if pamphlets have been put forth advocating that it is the work of man, it does not follow that the claim should be critically analyzed, unless the hypothesis is presumably supported by certain facts which evidently point in that direction.

At this late day it would be a work of supererogation to prove that the Giant's Causeway, in Antrim, Ireland, was not made by giants. It would devolve upon the affirmative not only to show that there was once a race of giants, but these people accomplished the work ascribed to them. If the negative demonstrates there never was a race of giants, then the theory necessarily falls. It has been fully demonstrated that no human being could possibly live with a height of ten feet.

However, it may not be out of place to present the following testimony to those who have not visited Fingal's Cave, that they might the better judge as to its being the result of the handiwork of man :

a. If the cavern has been chiseled, dug, pried, or blown out, there would have been certain noticeable markings on the remaining pillars. As these pillars are joined or united, for the most part, by the ball and socket joint, it would require tremendous power to unhinge them, unless the work should be commenced at the top of every pillar, or the joint chiseled half-way through. But the roof above disposes of the supposition that the work was commenced at the top ; and if

the chisel had been used, there would be traces on some of the remaining joints. A careful inspection presents no appearance whatever of human workmanship or ancient occupation. It is true there are evidences of recent art: for the steam-ship company that carries tourists to the island during the summer season, has put up such contrivances as make the exploration safe to visitors; also, the broken columns, over which the tourists walk, show more or less of defacement. But the upright columns and the broken pillars within the cavern, bear no trace of the chisel and the lever.

b. There is no evidence of ancient occupation on the island. There are the remains of sheep fanks, but these belong to the present century. Pre-Historic people were more superstitious and more susceptible to fear than those of a recent or an enlightened age. Notwithstanding the enlightenment and advantages of this century, it is impossible to induce any one to live on the island. A few years ago a shepherd and his family were persuaded to go on the isle, but they soon beseeched to be removed; because the hollow roar made by the sea through the caverns during times of storms sounded so dismally that they became terrified. To a barbarous people there would be something more than natural forces in the fetch of the ocean which bursts through these pillared portals, and with the roar, as of artillery, surging into the darkness beyond. So great is the thunder caused by these mighty surges that it is frequently heard on the Isle of Mull. Whether made by man or by Nature, the cave is of great age. If by the former, it was in an age of barbarity and superstition, and by a people who must have surmounted their fears, and by some art and device have supplied

themselves with the most approved machinery in order to excavate the rock to a depth of over twenty feet below the level of the sea.

c. When men engage in great undertakings or enterprises, it is with some definite object or purpose in view. If this cavern is of human origin it must not be assumed that it was excavated devoid of design. The undertaking, in its very nature and boldness, would be truly marvellous. There have been caverns formed for religious and other purposes. Scotland abounds in subterranean natural and artificial hiding places, permanent residences, etc. Among the most remarkable for constructive art and historic associations the well-known caves beneath the old tower of Hawthornden, near Edinburgh, may be mentioned. They have been hewn with great labor and ingenuity, in the rocky cliff which overhangs the river Esk. No tradition preserves the history or date of their execution, but concealment evidently was the design of the projector. The original entrance is most ingeniously made in the shaft of a very deep draw-well, sunk in the court-yard of the castle, and from its manifest utility as the ordinary and indispensable appenage of the fortress, it most effectually conceals its adaptation as a means of ingress and communication with the rock chambers beneath. (See Wilson's "Prehistoric Annals," p. 88.) Fingal's Cave could not have been designed either as a hiding place, or as a place of defense. Other isolated rocks, in the vicinity, may be seen much better adapted for a place of defense. On the island of Cairnburg, one of the Treshnish Isles, Sir John MacLean, with a handful of followers, was not only able to defy the British government for two years (1690-2), but also captured several ships laden with necessaries for the army in Ireland.

He did not even then capitulate until he received special orders from James II.

If it be contended that the cave was excavated for the purpose of inspiring religious awe and veneration for the mighty power and awfulness of the supreme God of the Druids, then it presupposes a knowledge of the effects which the lashings of the sea would have on the portals and broken columns. But if so designed, with a foresight so admirable, the spot selected was a most unfavorable one. The island is not only small, but during a high sea cannot be approached. Practically then the desired effect would be lost. If, however, such a design had been purposed, then the vast columns resting on the west coast of the southern arm of Mull would have been selected.

d. If Fingal's Cave is the work of man why may not the innumerable caverns of the Hebrides be assigned to the same origin? All of the caverns of Staffa would have just as plausible claims as would those on the adjacent islands, among which might be mentioned MacKinnon's and Lord Lovat's on Mull, and the remarkable one on the south side of Ulva, near a place called the Castles, and located about a quarter of a mile from the shore, the entrance being in the face of an abrupt rock rising perpendicularly to a height of one hundred feet,—the cave's height being thirty, breadth fifty-eight and length sixty feet, presenting the appearance of an arch having a span of thirty-seven feet. The roof and interior present the appearance of art as well as nature. It occupies an area of about thirty-five hundred square feet, and is used by the cattle during inclement seasons.

V. OUTWARD ASPECT.

The resisting power of basalt against the encroachments of the ocean, assisted by the sun, the freezings and thawings, the sudden changes in the weather, must be very great. Wherever the waves beat against the shore, however hard or durable the rock may be, still there is a certain amount of erosion, although the wasting of the rock may scarcely be perceptible. Standing before the adamantine-like pillars of Staffa it is impossible to believe, it is difficult to conceive how a cavern could be formed where a solid front is presented. Why should not the rock give equally at all points where the lashings of the waves are the same, unless a continuous weak seam occurs? If there should be a weak spot, having no considerable depth, then erosion would be more or less rapid until the fragile part had wasted away. The small cavity thus produced, would gradually widen until the exposed surface once more presented a comparatively smooth face. Is it likely that basalt would present a continuous seam of weak pillars, surrounded and held together by harder material? If there is a continuous line of softer pillars, the island of Staffa has not yet revealed it.

It may be safely affirmed that the material for the solution of geological problems can generally be found in the vicinity where the necessity arises for an answer. If there were no basalt or caverns in the immediate vicinity, save those columns forming Fingal's Cave, there is sufficient evidence in the structure itself to demonstrate by what process of nature it was excavated.

VI. LOCAL GEOLOGY.

I would not desire to affirm that the geological structure of the adjacent islands was necessarily involved in this consideration ; and yet a knowledge of it must be of interest and importance. There are certain features which may be advantageously used in solving the problem, and thus arrive at a clear understanding.

A surface view of the geology of the immediately surrounding country exhibits Staffa, Little Colonsay, the Treshnish Isles, Gometra, Ulva, the whole of the north-west as well as the Ross of Mull, and the south-western part of Morvern, to be of basaltic formation. Granite forms the extreme part of the south end and the extreme north-eastern coast of Mull. Iona, a part of the Ross of Mull, a portion of Inch Kenneth, a border on the opposite shore of Mull and the greater part of Morvern, belong to the Laurentian. Both Mull and Morvern present patches of the Upper Cretaceous with slight exposures of Jurassic. A closer inspection shows that Mull has been subjected to violent disturbances. Broken formations may be seen in almost every conceivable position. The central mountain group of Mull constitutes the remains of a great volcano. Professor J. W. Judd ("Quarterly Journal of the Geological Society," August, 1874, p. 259) estimates that the minimum elevation of the summit of this volcano was ten thousand feet ; while, at the present time, the highest point on the island is Ben More, which reaches an altitude of three thousand one hundred and seventy-two feet. Out of the tertiary volcano were hurled felspathic ashes, lapilli and scorix, followed by streams of trachytic lavas now forming felstones. After a long period of inactivity another eruption took place when

lavas, possessing great fluidity, poured out in great volumes and flowed to enormous distances, and in some places accumulated to a depth of two thousand feet. Since then the volcano has been extinct. The great basaltic plateau became broken up by decay and denuding agencies, caused not only by streams and fiords, but also by the erosions produced by the Great Ice Age.

During the later flow the island of Staffa appears to have been formed. The island is arranged in three beds, the lowest of which is composed of trap tufa over which the columns, or basalt proper, has been piled. The crest or cap is composed of amorphous basalt and broken or bent columns. As the sides of Fingal's Cave are composed of thick upright pillars and the roof of thin, gracefully curved and intricately interwoven shafts, it has been conjectured that the deposits belong to different ages. This view would be plausible if there was a basin-like formation. The same peculiarity is also observed in the clam-shell cave. A careful examination proves that these two varieties of columnar basalt form but parts of one lava stream, and that there is no reason for ascribing them to different epochs.

The many seismic convulsions which the Hebrides have undergone produced fissures, and in these rents were deposited materials of decay. To these disturbances we must, in a great measure, ascribe the vast number of caverns, which form such an important feature of the western coast of Scotland and her islands.

VII. CAVE EXPLORATIONS.

With a view to ascertaining what evidences were afforded by caverns concerning fissures being one of

the causes which led to excavations, I proceeded upon a tour of inspection. The first cavern visited was Lord Lovat's—anciently called Odin's—located in the extreme point of the peninsula of Laggan, which separates Loch Buy from the Firth of Lorn. The cavern is composed of three avenues: the main or entrance one, being three hundred feet in length; breadth, for the first hundred feet from the entrance, twenty feet, and the height forty feet. It then widens rapidly to forty-five feet, and its height increases, reaching an altitude, as it is claimed, of one hundred and twenty feet (? ?) These dimensions are retained to the extremity. Near the point of expansion on the west side, there is both a depression and a cavity in the wall. At the deepest part of the depression and almost against the wall is a fissure in the rock, wide enough to admit the body of a man. Descending into the fissure the second chamber is reached, the roof of which is on a level with the main avenue. It bears off in a west by north direction and extends a distance of about one hundred feet. The breadth and height vary,—the greatest dimensions being twelve feet in breadth by twenty-four in height. The floor is irregular, the lowest part being near the center. At the western extremity another chamber is reached, its direction being towards the main avenue and at right angles with it. It descends rapidly, and from a breadth of ten feet it soon terminates in a fissure of unknown height and depth. The fissure, instead of being perpendicular, bends towards the south at an angle of about ten degrees. The entrance to the main avenue is about fifteen feet above the sea level. The cavern was formed during a period of subsidence, and by the action of water through rock-fissures. The fetch of the ocean,

if the cavern was partly above water, would rapidly cut away such soft parts as might still cling to the walls.

MacKinnon's cave, on Mull, about eight miles east of Staffa, affords another example. This cave was made somewhat famous by Dr. Samuel Johnson, who visited it in 1773. Fortunately, Johnson's association with the young Laird of Coll and Sir Allan MacLean, had put him in better humor, in so much so that he could speak well of the cavern. He even went so far as to declare it "was the greatest natural curiosity he had ever seen" (Boswell). It is hardly probable the cave has changed any since Dr. Johnson saw it. It can only be reached by boat, and only then when the tide is out. The entrance is difficult of access owing to the rocks which lie in its front, and against which the incoming tide dashes. The entrance is forty-five feet in height. The roof rises in regular arched form, and is so high that the dim light furnished by the candles do not afford a good view. The depth is about two hundred feet, and in the innermost recess is another cave of about twenty-five feet in breadth. The roof and form of the outer cavern demonstrate that it was formed by the constant washing of a fissure.

From the head of Loch Buy to the Carsaig Arches are many caves and indentations in the rock, all of which are below the basalt. Near the entrance of Loch Buy, on the Carsaig side, is a large rock cut off from the cliff. It is composed of two parts, the base being cretaceous, and the upper part basaltic columns. A beautiful recess has been formed in this rock, extending through both formations. It has been used as a temporary residence within recent times.

The Carsaig Arches give us a very clear and definite idea how a cavern may be formed in basaltic pil-



CARSAIG ARCHES—EAST COAST OF MULL.

lars. (In our geological map of Mull, these arches should be located at Malcolm's Point.) These remarkable geological wonders, located just below Carsaig Bay, have been formed by the wasting away of the basaltic cliff. At this point the cliff rises to a height of nine hundred and seventy feet. The rock through which the excavations are made, have the oolite for the base and basalt for the covering. The larger arch is open at both ends, having a length of one hundred feet; height sixty feet, and breadth fifty-five feet. The smaller arch cuts through the detached rock, which is one hundred and twenty feet high, producing a cavity of seventy feet in height. The aperture was first produced in the softer material, and when this widened the basalt dropped from above,—aided by the erosions of the ocean.

The coast of Mull produces the evidence that caverns may be formed in basaltic rock, provided the same excavation extends into a softer formation lying under it. I could find no cave wholly in the basalt; and this is also true of my subsequent observations at the Giant's Causeway. This feature pressed itself forcibly upon my mind. If such an instance any-where in that region, other than at Staffa, occurred, I was very anxious to examine it. Fortunately for me, on the night of July 9th, 1887, I was the guest of Colin A. McVean, F. R. G. S., F. R. P. S., at his home, Kilfinichin House, Isle of Mull. Mr. McVean was born and brought up on Iona, served in the Admiralty Survey of the Hebrides; engineer of the Varna and Rustchuck railway, in Bulgaria, and surveyor-in-chief of Japan in 1870. Mr. McVean has an intimate knowledge of the entire topography of all the islands in his vicinity. In conversing with him on the geological

structure of Fingal's Cave, I asked him this question: "Barring the island of Staffa, do you know of any cavern, in this region, wholly in the basalt?" His reply was immediate and emphatic, "There is not one."

From what I was able to learn by personal explorations and an examination of the basalt in that region, I was forced to the conclusion that no caverns could be formed by any of the natural processes in the solid face of basaltic rock.

VIII. ORIGIN OF FINGAL'S CAVE.

The foregoing observations and results derived from personal investigations will assist us in arriving at a true solution of the origin of Fingal's Cave. We now come to the cavern itself. After viewing the wonder for a few moments, there were two noticeable features that impressed themselves on my mind: the first was that while the columns on the east side were perpendicular, those on the west leaned towards the east. Our frontispiece, taken from a photograph, shows the leaning columns. This is the only correct picture I have ever seen. The second feature was a slight fissure running the whole length of the cave in the very apex of the arch. I have failed to see any notice of these two features, by previous travellers, or writers. These features must of necessity have something to do with the solution of the problem.

Evidently then, there was a fault in the original rock, whether made at the time of deposition, cooling, or a seismic action, need not here be discussed. The fault need not have been in what is now the center of the cave, for the action of water is not according to mathematical rule. The slight fissure in the roof of the

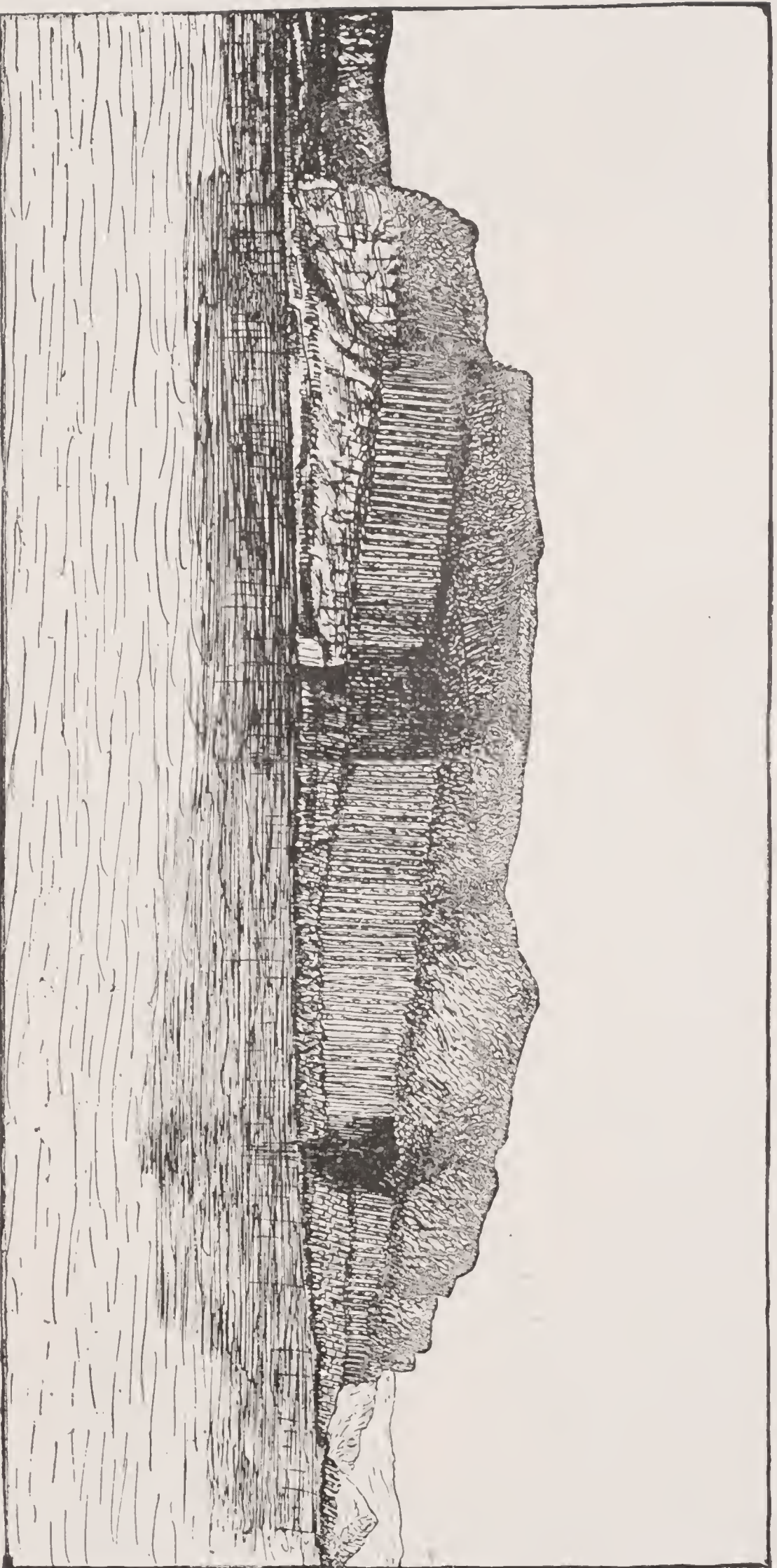
cave, of itself, does not prove it extended downwards to any considerable extent. If the respective faces of the perpendicular and the leaning pillars came together, however slight might be the angle, there is sufficient room for the action of water. The evidence does not rest here alone, for it is accumulative. As has already been stated, the columns rest upon a formation of basaltic tufa. The accompanying illustration shows the three formations, with the dip of the rock towards the east, also giving a view of Fingal's and the Boat Cave. The tufa is more susceptible to the action of water than the pure basalt. Some influence must be granted in this direction ; for the Boat Cave extends through both formations.

As it has been seen that the pillars on the west side of Fingal's Cave are not perpendicular, while those on the east are, it is plausible to assume two things: first, the aperture or fault was greater at the base than at the apex. If, however, it be assumed that these pillars were bent by the formation of short ones, at the base, then it would be answered that the short pillars must have been in the shape of a cone, while the actual pillars bear equal proportions throughout the entire length. The second inference is that these pillars may have leaned owing to a fissure in the rock upon which it stands, caused during the process of cooling.

There is another consideration deserving of special attention. Returning to the geology of Mull, we find sandstones, Upper Cretaceous and Jurassic rocks underlying the columns of basalt. All about Carsaig Bay, we find the summits of the hills rising from seven hundred and eighty five to fourteen hundred and seventy feet above the sea, composed of columnar basalt, some of the columns of which are over four feet in di-

Boat Cave.

Fingal's.



COLONNADE SHOWING BOAT AND FINGAL'S CAVE.

Fig. 10.—Generalized Section of the Strata exposed at Cursair, on the South shore of the Isle of Mull.

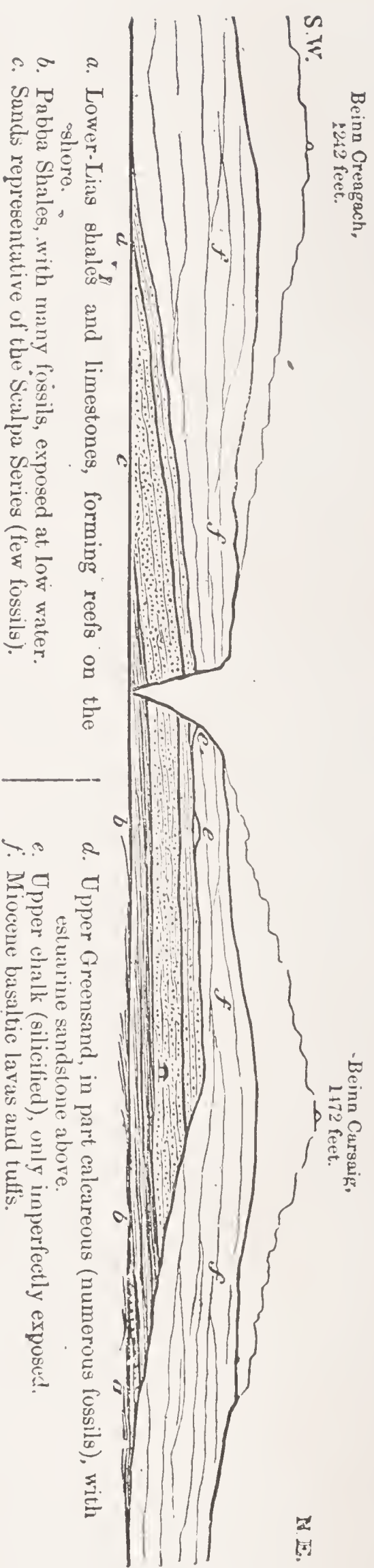
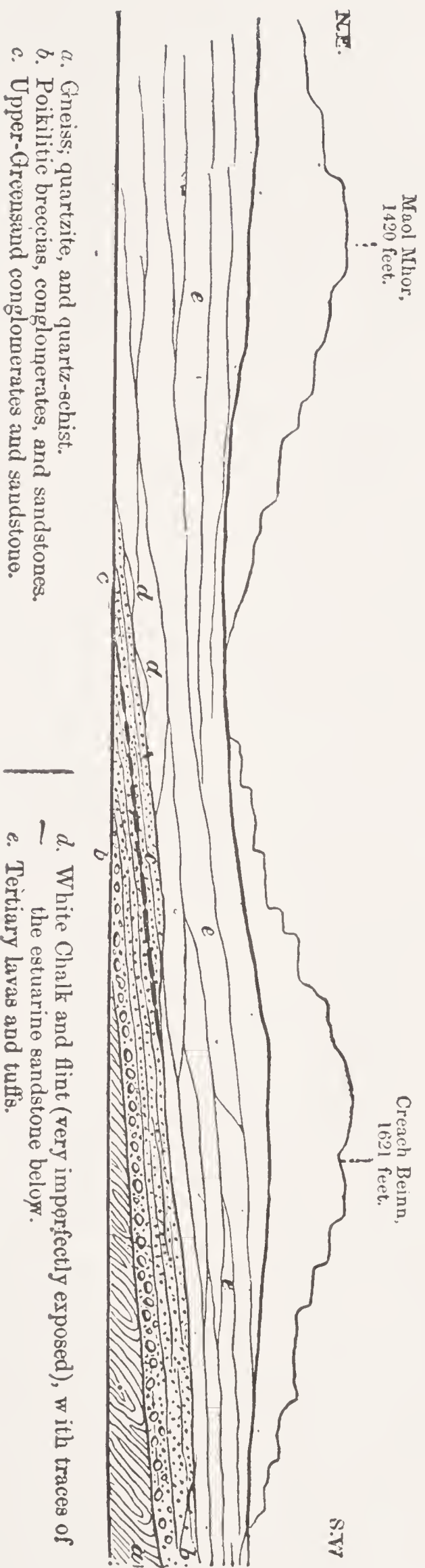


Fig. 11.—Generalized Section at Gribun, Isle of Mull.



ameter. At the base of the declivity, when the tide was out, I gathered many specimens of ammonites and other varieties of fossils. This formation extends under a flinty chalk-bed, over which lies the basalt. In the rocks under the basalt the caverns are numerous. The basaltic tufa of Staffa must either rest upon the same formation or else upon the Laurentian, which is exposed on Iona.

The water having excavated, in the softer rock under what is now Fingal's Cave, a cavern of sufficient size was formed to weaken the roof or rock above; in consequence of which, the columns already partially disjointed sank into the cavity, thus producing a large fissure which would be more exposed to the action of the waves. This depression was partly the cause of the broken columns within which are formed steps upon which the traveller treads in order to gain the interior. This view is forcibly illustrated in the formation of the Carsaig arches.

The considerations herein set forth lead me to the following conclusions:

a. The dip of the rock of the island of Staffa indicates there must have been a disturbance after the basalt had been deposited, which must have produced more or less crevices in the rocks.

b. The action of water has made a large excavation under and in the basaltic tufa, which action was facilitated by a fault or fissure in the rock.

c. The action of the water under and against the basaltic tufa, caused an erosion sufficient to unsettle the basaltic columns above.

d. This removal or wasting of the pillars was hastened by a flaw or fissure existing between them.

IX. ANTIQUITIES.

It is not designed here to treat of the antiquities on the islands adjacent to Staffa. They resolve themselves into Prehistoric, Danish, Gaelic, and Ecclesiastical. Of the first the finest is the Druidical circle near the head of Loch Buy on the plain of Magh. Another circle may be seen at the head of Loch Scridain, on a farm called Rossal. Another occurs near the head of Loch na Lathaich, on the Ross of Mull. On the height, near the head of Loch Cuinn, is a circle composed of five stones; and on Ardnamurchan, east of Mingary Castle, is another circle. Standing Stones are more or less numerous, and by the people are called Carragh, which means a pillar, a monument. A vitrified fort is on the north-eastern border of Loch Tearnate, while tumuli may be seen in various localities; the largest of which is on Morvern, called Carna-Caillich. Graves, containing stone coffins, are of frequent occurrence.

A series of stone towers, within view of each other, are seen on the Isles. The remains of old feudal castles and ecclesiastical buildings are very numerous. Prominent among the former are Duard, Ardtornish, Mingary, Moy and Breachacha Castles; and among the religious houses, those on Iona and Oronsay are known wherever the history of the Christian Church has been read.

X. ACKNOWLEDGMENTS.

It is but just that I should acknowledge my obligations to The MacLaine of Lochbuie and The MacLean of Pennycross, who did all within their power to assist

me in the prosecution of my labor. They appeared to anticipate my wants and provided means for my conveyance. Without this assistance, a stranger in a strange land, although treading the ground of my forefathers, my work, at that time, could scarcely have been performed.

The great kindness of Miss Guthrie, of London, deserves to be specially mentioned. Without the asking she placed at my disposal her good steam-yacht, *The Lussa*, which thus enabled me to visit Iona, Staffa, Colonsay, Oronsay, and the Garvelloch, or Holy Islands.

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